ROOST SELECTION AND BEHAVIOR OF THE LONG-EARED OWL (*Asio otus*) WINTERING IN NEW JERSEY

Thomas Bosakowski

Abstract - Roosting Long-eared Owls (*Asio otus*) selected conifers with dense foliage that concealed all or most of the main trunk with no apparent regard to tree species. Roosts were established only in clumps of 2 or more closely-spaced conifers (3-15 m in height), always near a variety of open habitats. Communal roosts of 2-4 owls were significantly preferred to solitary roosts. Strong fidelity for a single roosting tree was observed within each winter, although the owls shifted to a new main roost site each yr. Owls concealed themselves in dense foliage; when approached, they would hide or freeze and flush only at close distances. Evidence indicated that these owls had habituated to remarkably close human activity, although they were readily able to detect an intruder. The 2 most frequented roosts were within 8 m of large buildings which may have provided wind protection and increased shade for hiding. The owls remained at roosts well into darkness and when flushed during the day, showed strong aversion to daylight activity.

While the food habits of wintering Long-eared Owls (*Asio otus*) have been extensively studied (see reviews by Marti 1976; Voight and Glenn-Lewin 1978), the literature on roosting sites and attendant behavior is limited and few of the observations have been systematic (Glass and Nielsen 1967; Smith 1981). Here, I document systematic counts of roosting Long-eared Owls in man-made habitat where all vegetation was landscaped and planted in orderly patterns (i.e., an industrial park and a cemetery). This eliminated many of the habitat variables normally encountered in natural ecosystems and facilitated the identification of essential roost-site requirements.

Study Area and Methods

Observations on roosting Long-eared Owls were made from 18 January 1981 to 10 March 1984 in the Hackensack Meadowlands District, New Jersey. This area contains estuarine marshes that border the lower Hackensack River. These extensive open marshes are dominated by common reed (*Phragmites communis*), interspersed with small tidal channels and creeks. Ornamental conifers were distributed in a nearby industrial park (office and warehouse buildings).

In 1981, all conifers within 1 km of the originally-discovered roost were checked for owls and/or their sign (pellets, prey remains, feathers, urates). I found that all roosting activity was limited to one 22 ha block of the industrial park. In 1982, I systematically searched this block for roosting owls with 9 flush counts (Craighead and Craighead 1956), by closely inspecting 77 conifers on each census date. These conifers were 2-6 m high and were the following: 73 Austrian pine (*Pinus nigra*), 2 eastern hemlock (*Tsuga canadensis*), and 2 Atlas cedar (*Cedrus atlantica*). The number of flush counts was kept to a minimum and their timing was designed to obtain the most information with the least amount of disturbance to the owls (Table 1). At approximately monthly intervals, other conifers within 1 km were checked but signs of roosting were not revealed. After the snow cover had melted in early February of 1982, pellets were found and collected on each of the last 6 flush counts. A record of the number and location of pellets provided an additional measure of roost-site use, for each owl ejects approximately 1 pellet per day at the roost (Craighead and Craighead 1956; Birkenholz 1958; Graber 1962). Analysis of these pellets was reported previously (Bosakowski 1982). During the winter of 1982-83, neither owls nor pellets were found during 17 systematic searches. In the winter of 1983-84 the roosts became active again and 9 systematic searches (including pellet collections) were conducted.

Results and Discussion

Roost Trees. — In the study block, I observed Long-eared Owls roosting in 4-6 m ornamental Austrian pines (36 times) and once in a 2 m hemlock. A few additional observations were made at a cemetery about 2 km from the study block during the second winter. Here, 1-3 Long-eared Owls roosted in a planted row of 4-5 m ornamental arborvitae (*Thuja* spp.) and in a row of 10-15 m hemlocks. Although Long-eared Owls typically exhibit a strong preference for roosting in conifers, a preference for certain species has not yet been indicated (Randle and Austing 1952; Smith 1981; this study). Density of foliage is probably of most importance since it provides protection from windchill, precipitation, predators, and mobbing birds. In this study the trees selected for roosting were those that offered the greatest foliage density and concealment of the main trunk. Smith (1981) noted that roost trees had extensive branching to within 2 m of the ground.

Roost-site Use and Characteristics. — In the study block, virtually all roosting was confined to 2 roost sites (Fig. 1). In 1981, the owls showed a strong fidelity for roost 1 as demonstrated by the lack of sightings and pellets elsewhere in the study area. In 1982, 1 or 2 owls stayed in roost 1 for a short period (10 pellets) and joined other owls (maximum = 3) at roost 2 for the remaining winter

Table 1. Systematic flush counts of Long-eared Owl roosts.

DATE		ROOST 1		ROOST 2	
		OWLS	PELLETS	OWLS	PELLETS
First Winter					
20 January	1981	1	+[a]	0	0
31 January	1981	2	+	0	0
Second Winter					
01 January	1982	0	0	0	0
24 January	1982	1	NC[b]	3	NC
26 January	1982	2	NC	1	NC
04 February	1982	0	10	3	85
10 February	1982	0	0	3	15
23 February	1982	0	0	3	9
02 March	1982	0	0	1	8
18 March	1982	0	0	1	14
24 March	1982	0	0	1	1
Third Winter[c]					
31 October 1982- 4 April 1983		0	0	0	0
Fourth Winter					
18 December	1983	0	0	0	0
31 December	1983	4	27	0	0
07 January	1984	0	26	0	0
20 January	1984	4	NC	0	NC
28 January	1984	3	52	0	0
04 February	1984	2	25	0	0
20 February	1984	2	32	0	0
04 March	1984	0	1	0	0
10 March	1984	1	3	0	0
Totals:		22	176+	15	132

[a]pellets present but not collected during first winter.
[b]pellets not collected because of snow cover.
[c]a total of 17 counts were made during this period.

(132 pellets) (Table 1). In 1983 there was no evidence of roosting during the entire winter season. This may have been the result of mild temperatures during December and January as compared to other years (Fig. 2). In 1984 only roost 1 was used by 1-4 owls.

Roost 1 consisted of a cluster of two 4 m Austrian pines that were 2 m apart, three 1 m evergreen shrubs, a 2 m hemlock, and a 6 m white birch (*Betula pendula*). The trees were planted on a 0.5 m mound, bordered with small boulders. Roost 2 was a row of ten 3-5 m Austrian pines that were planted so that the foliage met between almost every tree. The preference of Long-eared Owls to select roost trees

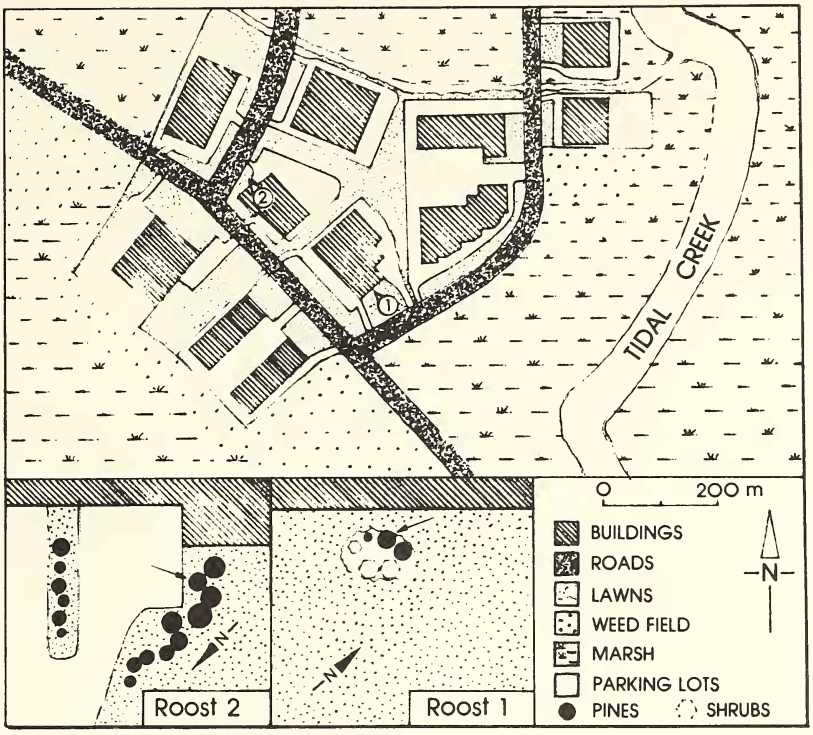

Figure 1. Map of study area with inset maps showing close-up views of two Long-eared Owl roosts. Small arrows indicate most frequently-used roost trees. Systematic searches were conducted in the center block (study block).

from among clumps of two or more conifers was also noted by Bent (1938:153), Randle and Austing (1952), and Birkenholz (1958).

The two roosts that were selected represented 2 of 4 apparently-suitable pine plantings in the study block, yet the other pine groups showed virtually no signs of use during the study (2 and 6 pellets found). The two favored sites were closer to buildings (6-8 m as compared to 19-25 m) and as a result, received less direct sunlight. Protection from the prevailing northwesterly winds was apparent at roosts 1 and 2 but not at the little used pine groups. While the eastern site (roost 1) was shielded directly by the adjacent building, the western site (Roost 2) was also protected by being on the southeastern side of the pine row (Fig. 1).

Roost-site Fidelity. — The fidelity of Long-eared Owls to certain trees within the favored roost sites was evident, e.g., in 1982 there were 119 pellets under one tree in roost 2 and only 27 pellets under 7 additional trees. In 1984 the results were similar at roost 1 with 147 pellets under 1 tree and 67 pellets under 9 other trees. Some pellets found at alternate roost trees were the result of owls temporarily moving after I flushed them. The Craigheads (1956:88) mentioned the habit of Long-eared Owls to return to the same roost tree and noted one owl on the same perch on 9 consecutive roost counts. I observed 1-3 owls roosting in the same tree on 7 consecutive roost counts (54-day period). Smith (1981) reported the fidelity of Long-eared Owls to certain groups of trees over a period of many years, but no reference was made to fidelity to individual trees.

While I observed a strong fidelity to one roost site during each winter, it was surprising that the owls established their main roost at a different site each year, alternating between roost 1 and roost 2 (Table 1). These data seem to indicate that the initial selection between two suitable roosts is a rather fortuitous event and that a strong site-tenacity develops thereafter. Similarly, Klopfer and Hailman

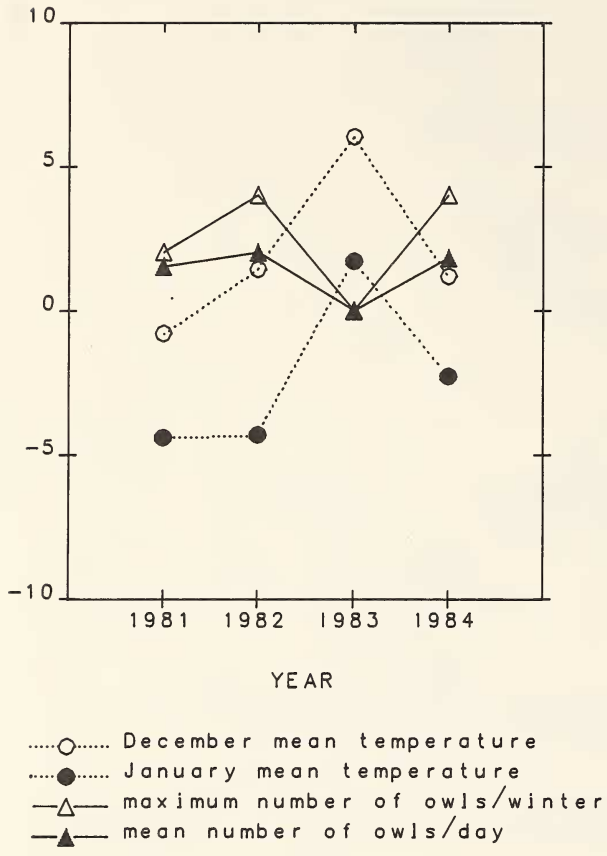

Figure 2. Inverse relationship between mean winter temperatures (°C) and owl numbers occurring in the study area. Weather data was obtained from National Weather Service at Newark International Airport located only 13 km from the study site.

(1965:291) have postulated that in their study only one of several available sites was occupied by gulls because of social stimulation.

Proximity to Hunting Areas. — According to the literature, Long-eared Owl roosts are almost always located near open habitats. The significance of this association was revealed by Randle and Austing (1952) who found a "preponderence" of open-field prey species in the pellets. A review of numerous food habits studies (Marti 1976) confirms this finding and suggests that the majority of hunting occurs in open country. In the present study, both roosts were within 200 m of large *Phragmites* tidal marshes. In addition, five man-made habitats were also present: a few small weed-covered fields (total 15 ha), 2 bulldozed construction sites (8 ha), parking lot and road edge, lawns surrounding the roosts, and large sanitary landfill mounds (70 ha). Hunting in these "disturbed" habitats may have accounted for the unusual dominance of *Mus musculus* in the pellets (Bosakowski 1982).

Roosting Behavior. — In most cases owls concealed themselves completely in a dense portion of the conifer and were not visible until flushed or an intention movement was made. Consequently, it was not always possible to accurately note information such as roosting height, distance from trunk, or individual distances.

On one occasion, a Long-eared Owl was perched on a completely exposed branch, but when I approached, it hopped along several branches and hid behind the tree trunk while keeping a continuous watch in my direction. Similar hiding behaviors were observed on 3 other roost counts. On 2 other occasions, owls were seen trying to avoid detection by elongating their posture, erecting their ear tufts and closing their eyelids nearly completely. The resultant motionless form was maintained unless I approached closer than 3-4 m; then the owls flushed. This concealing posture was identical to the "broken branch" appearance described in Bent (1938:163). Another time, I observed a person, unaware of the owl roost, walk within 4 m of an owl that was roosting on an exposed branch, but the owl remained undisturbed. However, when I approached within 9 m and looked directly at the same owl, it began staring intently, quickly rotated its head back and forth, and then flushed. These contrasting observations suggest that Long-eared Owls will habituate to nearby human traffic, but are readily able to discriminate when they are being watched. Such selective attention to a predator's eyes (in this case, the author's) can have considerable survival value (Suarez and Gallup 1983) in that prey species can monitor the direction of a predator's visual focus and may be able to take advantage of better escape opportunities (Gagliardi et al. 1976). Randle and Austing (1952) reported a similar ability of Long-eared Owls to discern scattered members of a searching party and change the direction of their escape flight accordingly.

Communal Roosting. — In general, these owls roosted or flushed between 2 to 3 m above ground. When 2-4 owls roosted communally, they were

typically distributed on different branches at varying heights. Only once were 2 owls seen roosting together on the same branch. When more than one owl was present in the study block, communal roosting was significantly preferred ($\chi^2 = 18.0$, d.f. $= 1$, $P < 0.001$) with only 4 solitary roostings observed. Fleming (1981) lists the five most accepted explanations for communal roosting: (1) a shortage of roost sites, (2) huddling for body heat conservation, (3) predation risks, (4) a tendency to exchange information on patchy food locations, and (5) to assess population size in relation to resources. Although suitable roost sites were not plentiful in the study area (hypothesis 1, Fleming 1981) my data show that a major roost can be totally ignored in successive years with the owls clustering at another nearby site. Clustering is not related to huddling (hypothesis 2, Fleming 1981), for the closest individual distance observed was 0.4 m. Reduction of predation risks (hypothesis 3, Fleming 1981) has probably been a major 'ultimate' factor in favor of these owls forming communal assemblages. During many flush counts, one owl would usually detect me first, and then the others apparently were alerted by either intention movements or by the sound of the first bird flushing. Furthermore, when several owls flush simultaneously, momentary confusion may be experienced by an advancing predator. Post (1983) speculated that in a solitary hunting species, communal winter roosts have probably evolved as an anti-predator mechanism. However, hunting by Long-eared Owls may not be a completely solitary event since some owls may follow others to profitable hunting grounds. Therefore, the effect of hypothesis 4 (Fleming 1981) remains unknown for the Long-eared Owl. Finally, I agree with Schnell (1969) that the plausibility of hypothesis 5 (Fleming 1981) is questionable and not likely to be tested in the field.

Flushing Behavior. — The view of the owls was frequently obstructed by dense cover or they were dozing with closed or partially closed eyes. Hence the flushing distance was usually between 2 to 4 m with a quiet approach (no crusty snow or leaves). During the study period, the owls were flushed a total of 22 times, either singly or in groups. On 8 occasions, some owls immediately returned to the same roost site within a period of several min. Two owls attempted to return repeatedly (4 and 6 times) to the same roost tree within 10 min of being flushed. Apparently disturbed by my presence, these owls were unable to resettle at each return. This reluctance to leave the roost has not been previously described, but was probably related to the scarcity of roosting cover in the study area. Owls that did not attempt an immediate return to the roost were generally seen perched in the nearest available conifers. This further attested to the strong aversion of Long-eared Owls for daylight activity. Like the observations of Randle and Austing (1952), the owls I studied were often clumsy and disoriented when flushed, and twice were observed to fly into black non-reflective windows of an adjacent building. Apparently, the dark windows were mistaken for large cavities. No injuries were evident and the owls continued to seek cover immediately. The tendency of Long-eared Owls to hide, freeze and flush only at close distances explains why this raptor is able to roost very close to human habitations.

Roost Departure. — The nocturnal inclination of the Long-eared Owl was further characterized by their late emergence at dusk. On 2 evenings, owls were still roosting 26 and 40 min after sunset at roost 2, but on 2 other evenings, could not be found at this roost 49 or 81 min after sunset. From these 4 evenings, it appears that roost departure is most likely to occur between 40 and 49 min after sunset. Similarly in England, Armitage (1968) observed a group of Long-eared Owls on one night departing from the winter roost 35 min after sunset. In Denmark, Glass and Nielsen (1967) observed departures of Long-eared Owls from a winter roost on 40 nights and found a departure time of 39 ± 8 ($\bar{X} \pm$ S.D.) min after sunset.

ACKNOWLEDGMENTS

I thank Robert Speiser and Richard Kane for valuable discussions throughout the course of the study and for their critical reading of the manuscript. Appreciation is also extended to Drs. John H. Edgcomb, Frances N. Hamerstrom, Kevin L. Keim, Carl D. Marti, and Clayton M. White for reviewing various drafts of the paper. Robert Pitler provided encouragement and suggestions about the project. Dr. Arthur A. Levin assisted with graphics.

LITERATURE CITED

ARMITAGE, J.J. 1968. A study of a Long-eared Owl roost. *Naturalist* No. 905:37-46.

BENT, A.C. 1938. Life histories of North American birds of prey. *U.S. Natl. Mus. Bull.* 170:482 pp.

BIRKENHOLZ, D. 1958. Notes on a wintering flock of Long-eared Owls. *Ill. Acad. Sci. Trans.* 51:83-86.

BOSAKOWSKI, T. 1982. Food habits of wintering *Asio* owls in the Hackensack Meadowlands. *Records of N.J. Birds* 8:40-42.

CRAIGHEAD, J.J. AND F.C. CRAIGHEAD, JR. 1956. Hawks, owls and wildlife. Stackpole Co., Harrisburg, Pa.

FLEMING, T.H. 1981. Winter roosting and feeding behavior of Pied Wagtails *Motacilla alba* near Oxford, England. *Ibis* 123:463-476.

GAGLIARDI, G.J., G.G. GALLUP, JR., AND J.G. BOREN. 1976. Effect of different pupil to eye size ratios on tonic immobility in chickens. *Psychonomic Science* 8:58-60.

GLASS, M.L. AND T.H. NIELSEN. 1967. The evening departure of the Long-eared Owl (*Asio otus*) from the winter roost. *Dansk. Ornithol. Foren. Tids.* 61:100-106.

GRABER, R.R. 1962. Food and oxygen consumption in three species of owls (Strigidae). *Condor* 64:473-487.

KLOPFER, P.H. AND J.P. HAILMAN. 1965. Habitat selection in birds. *In*: Advances in the study of behavior. (Eds. D.S. Lehrman, R.A. Hinde, and E. Shaw). Vol. 1, Academic Press, New York.

MARTI, C.D. 1976. A review of prey selection by the Long-eared Owl. *Condor* 78:331-336.

POST, W. 1982. Why do Grey Kingbirds roost communally? *Bird Behavior* 4:46-49.

RANDLE, W. AND R. AUSTING. 1952. Ecological notes on Long-eared and Saw-whet Owls in southwestern Ohio. *Ecology* 33:422-426.

SAUREZ, S.D. AND G.G. GALLUP, JR. 1983. Emotionality and fear in birds: A selected review and reinterpretation. *Bird Behavior* 5:22-30.

SCHNELL, G.D. 1969. Communal roosts of wintering Rough-legged Hawks (*Buteo lagopus*). *Auk* 86:682-690.

SMITH, D.G. 1981. Winter roost site fidelity by Long-eared Owls in central Pennsylvania. *Amer. Birds* 35:339.

VOIGHT, J. AND D.C. GLENN-LEWIN. 1978. Prey availability and prey taken by Long-eared Owls in Iowa. *Am. Midl. Nat.* 99:162-171.

Dept. of Zoology and Physiology, Rutgers University, Newark, NJ 07102. Present address: Dept. of Toxicology and Pathology, Roche Research Center, Nutley, NJ 07110.

Received 6 September 1984; Accepted 21 January 1985